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DEVELOPMENT OF CERAMIC MINI-FACTORIES

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The initial conditions and the factors that need to be taken into account in setting up ceramic mini-factories and in their subsequent evolution are identified.

The organization and subsequent progress of ceramic mini-factories require, in our opinion, an objective evaluation and inventory of the starting conditions, since an analysis of the performance of such enterprises and identification of the reasons for their decline in new economic conditions confirm the necessity of identifying the role and the significance of each factor affecting the functioning of such enterprises taking into account their dynamics and the continuous renovation of the product range of ceramics, especially household ceramic articles.

The Institute of Ceramic Machine-Building has developed modular technologies and designs for ceramic mini-factories [1 – 3]. Next, the Keram-Servis company was set up, which renders assistance in setting up other mini-factories for production of ceramics. In doing so, we identify and take into account various predictable and unpredictable factors: financial possibilities; products and their materials; production technology; production space; professional skills of the staff; methods for upgrading products; ways for expanding production, and other factors such as promotion and marketing.

The technology is based on machinery consisting of modular systems for fine milling of rocky materials, dissolution of argillaceous materials, mixing, sieve-magnetic concentration, dehydration of slip, vacuum treatment of mixtures, molding, drying, glazing, decorating, firing, etc.

In addition to that, the Keram-Servis company based on local materials produces a porcelain mixture and a glaze suspension used by other mini-factories to manufacture products by casting, extrusion, layer flattening, molding, and glazing. For this purpose, the ceramic laboratory of the Institute has carried out expert evaluation of raw materials, optimized the mixture composition, and produced prototype batches of the porcelain materials. Moreover, personnel has been trained, and assistance rendered in the start-up of production.

The chemical composition of the raw materials used for preparing the porcelain mixture and the glaze suspension is shown in Table 1. A distinctive feature of the glaze is its low fusibility (1180°C).

To compete in the market, special attention is paid to the quality of the porcelain materials produced. This quality is ensured not only by compliance with the technology procedures at each stage and each workplace, but also taking into account the philosophy of production prevalent in the world: Defective products, inefficient control, low-skill staff, lack of order and cleanliness at the working places, errors, employees whose salaries are not related to their labor effort, etc.,

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TABLE 1

Component	Mass content, %								
	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	calcination loss
Prima-Vesco batch	51.0 – 52.0	32.0 – 33.0	0.8 – 1.1	1.1 – 1.5	0.8 – 1.0	0.8 – 1.0	1.9 – 2.1	0.4 – 0.5	8.2 – 10.0
Prosyanovskoe kaolin KFN-3	44.5 – 46.0	36.0 – 37.0	0.6 – 0.8	0.1 – 0.5	0.2 – 0.8	0.55 – 0.7	0.9 – 1.1	0.3 – 0.4	13.5 – 13.8
Quartz sand OVS-015-1	99.0 – 99.5	0.18 – 0.20	0.0015 – 0.05	0.01 – 0.04	0.2 – 0.35	0.06 – 0.1	0.04 – 0.06	0.05 – 0.07	0.65 – 0.7
Eliseevskoe pegmatite KPShM-02	73.5 – 74.0	14.2 – 15.4	0.45 – 0.56	0.08 – 0.12	1.2 – 1.4	0.1 – 0.25	4.5 – 5.0	4.3 – 4.9	0.6 – 0.8
Dolomite	At most 3	At most 1.5	At most 1.5	–	–	At least 19.0	–	–	–
Frit	47.5 – 48.0	7.8 – 8.1	Is not standardized		7.3 – 7.8	14.5 – 14.6 B_2O_3	4.3 – 4.6 BaO	5.02 – 5.2	8.9 – 9.3 ZrO_2

TABLE 2

Production stage	Parameter	Periodicity	Norm	Control method	Equipment and instruments	Supervising person
			Porcelain mixture			
Warehouse	Moisture of material	Each batch	–	Gravimetric	Drying cabinet, laboratory scales (GOST 24104–88)	Technologist
Dosing of components	Component weight	Each weighing	According to the formula	The same	Platform scales (TU 25061296–79)	Batch-milling operator, technologist
Milling and slip preparation	Slip moisture before pouring into filter press	Each batch	55 – 60%	″	Drying cabinet, laboratory scales	Technologist
	Milling fineness (residue on a No. 0063 sieve)	The same	Not more than 2%	By GOST 21216.12–84	Drying cabinet, laboratory scales, sieve with mesh No. 0063 (GOST 6613–86)	The same
Dehydration of slip	Moisture after filter press	″	20 – 22%	Gravimetric	Drying cabinet, laboratory scales	″
			Glaze suspension			
Warehouse	Moisture of material	Each batch	–	Gravimetric	Drying cabinet, laboratory scales	Technologist
Dosing of components	Component weight	Each weighing	According to the formula	The same	Platform scales	Batch-milling operator, technologist
Milling and preparation of glaze suspension	Glaze moisture	Each batch	50 – 55%	″	Drying cabinet, laboratory scales (GOST 24104–88), weighing bottles (GOST 23931–90)	Technologist
	Milling fineness (residue on a No. 0063 sieve)	The same	Not more than 0.1%	Residue on the sieve	Sieve with mesh No. 0063 (GOST 6613–86), laboratory scales (GOST 24104–88), drying cabinet	The same
Glaze suspension	Spreading quality	″	Luster and uniform spreading	Fire test	Electric furnace (100 liters, PÉ-0.1/1260)	″

make the staff dissatisfied with their jobs and, accordingly, result in poor performance.

All machinery and equipment is made by the Keram-mash JSC and laid out as two non-intersecting production lines; one line produces the porcelain mixture, and the second one produces the glaze suspension. The production is based on the standard ceramic technology. The raw materials are stored in individual compartments and containers, separately for the porcelain mixture and for the glaze suspension. The quality of all raw materials is verified to comply with the special standard requirements (Table 2). The Prima-Vesco batch of increased moldability based on refractory clays from the Avdeevskoe and Veselovskoe deposits is used. The use of milled raw dolomite from the Dokuchaevskoe deposit in glaze suspension ensures an intense fluxing effect in glaze melting and facilitates a decrease in the TCLE of the glaze, which reduces the risk of crackle.

Milling of raw materials for slip preparation is carried out by wet grinding in a ball mill in two stages:

– milling of grog components and fluxes adding 7 – 10% clay materials from the total amount of rocky materials (half of the estimated quantity of water is added);

– joint milling of grog components, fluxes, and argillaceous materials (the remaining part of the water is added).

The glaze suspension is prepared by joint wet milling of all initial components in a ball mill in one stage.

The sieve-magnetic concentration of slip and suspension is carried out using vibration sieves and electromagnetic separators. The dehydration of slip and the vacuum treatment of the plastic porcelain mixture is carried out on filter presses and vacuum presses.

Thus, the use of materials produced by Keram-Servis by other ceramic mini-factories producing household porcelain using casting, extrusion, flattening of plastic mixture, molding, etc., allows these factories to eliminate the stage of preparation of material from their production process.

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